

THE WHITE PEACH SCALE, *PSEUDAULACASPIS PENTAGONA*
(TARGIONI-TOZZETTI) (HOMOPTERA: DIASPIDIDAE):
EVIDENCE THAT CURRENT CONCEPTS
INCLUDE TWO SPECIES¹

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Abstract.—Evidence is presented that the current species concept of the white peach scale, *Pseudaulacaspis pentagona* (Targioni-Tozzetti) is incorrect and actually includes two species, *P. pentagona* and the white prunicola scale, *P. prunicola* (Maskell). Characteristics used to distinguish between the species include body microstructures, egg colors, host differences, distribution patterns, life history differences, and host transfer data. New data are given on synonymies, morphologies, hosts, distributions, and life histories. First instars and second-instar males of each species were studied but no conspicuous species differences were found.

The white peach scale, *Pseudaulacaspis pentagona*, was described by Targioni-Tozzetti in 1886 from several localities in Italy. Since then, other alleged species have been described and subsequently synonymized with *P. pentagona*, including *Pseudaulacaspis prunicola* (Maskell, 1895).

In the course of research on the economic scale insects of the United States, we noted that Kawai (1980) had treated *P. prunicola* as a species distinct from *P. pentagona*. Since *P. prunicola* has not been reported from the United States, we investigated the distinctiveness of these species further.

The purpose of this paper is to demonstrate that the traditional concept of *P. pentagona* is partially incorrect, and that this taxon actually is composed of two cryptic species. The second species is *P. prunicola*.

MATERIALS AND METHODS

The preliminary search for taxonomic characters involved a detailed examination of 15 specimens of each species from as many localities and hosts as possible. After preliminary morphological differences were discerned, 70 specimens of *P. prunicola* and 74 specimens of *P. pentagona* were used for determi-

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nation of ranges and means. Levels of significance were determined using a standard *t*-test.

Field samples were collected on the College Park Campus, University of Maryland, at irregular intervals from May 27 to October 16, 1981. Branches about 15 cm long were clipped from the host and were examined using a Wild M-5 dissecting microscope at magnifications of 10–60×. At least 15 specimens were examined during each observation; stages present were recorded. *Pseudaulacaspis pentagona* was sampled from a 10 m tall *Morus alba* L., and *P. prunicola* was sampled from a 5 m tall *Prunus serrulata* Lindl. Several additional, life history observations were made in 1982 by Dr. Tova Rivnay in the National Arboretum, the Lyndon B. Johnson Grove, and the East Potomac Park, Washington, D.C.

Laboratory colonies were established from the field populations mentioned above. Transfers were made by placing heavily infested twigs about 7 cm long on top of scrubbed, Idaho russet potatoes. The twigs were removed after 3 weeks. The stock colonies of each species were kept in separate rooms to avoid accidental cross contamination. The rooms were maintained at about 20°C. After two generations on the potatoes, 30 specimens of each species were mounted in Hoyer's mounting medium and examined to see if any morphological differences could be detected between the colony on the potatoes and the source colony. Illustrations were prepared using a Zeiss, phase contrast microscope at magnifications of 256, 640, and 1600. Type material or specimens identified by the author of each junior synonym have been examined.

RESULTS

The following information is not intended to be an exhaustive treatment but includes only data pertinent to distinguishing between *Pseudaulacaspis pentagona* and *P. prunicola*.

Pseudaulacaspis pentagona (Targioni-Tozzetti)

Fig. 1

ESA approved common name.—White peach scale.

Synonyms and combinations.—*Diaspis pentagona* Targioni-Tozzetti 1886: 2; *Diaspis amygdali* Tryon, 1889: 89; *Diaspis lanatus* Morgan, 1892: 137; *Diaspis patelliformis* Sasaki, 1894: 107; *Aspidiotus vitiensis* Maskell, 1895: 40; *Diaspis geranii* Maskell, 1898: 228; *Aulacaspis (Diaspis) pentagona* (Targioni-Tozzetti): Newstead, 1901: 173; *Sasakiaspis pentagona* (Targioni-Tozzetti): Kuwana, 1926: 9; *Aspidiotus lanatus* ("Cockerell"): Ferris, 1941: 45.

Type material.—We have examined specimens of the following junior synonyms and have confirmed that they are the same as *P. pentagona*. *Diaspis amygdali* Tryon—6 slides with label "Diaspis/amygdali/Mask./Australia/Mask. Coll. No. 292." *Diaspis lanatus* Morgan—1 slide with label "Diaspis/lanatus Ckll./On Capsicum/Kingston, Jamaica/T.D.A. Cockerell from Type material." *Diaspis patelliformis* Sasaki—2 slides with label "6025. Diaspis/pattelliformis (sic)/Saraski. (sic)/Mulberry. Milo, Japan/P. Takabashi. (sic)"; according to notes made by Pergande when the material was received, the specimens were collected November 20, 1893 and were sent by Takahashi as dry material. *Aspidiotus vitiensis* Maskell—8 slides with label "Aspidiotus/vitiensis/Mask./Fiji/Mask. Coll. No. 4.5." *Diaspis geranii* Maskell—6 slides with label "Diaspis/geranii/Green/Ceylon/Mask.



Fig. 1. *Pseudaulacaspis pentagona*, adult female, Hartford Co., North Carolina, IX-29-58, on "umbrella tree." A, Gland spine in third space. B, Bifurcate and trifurcate gland spines. C, Small macroducts. D, Large macroduct. E, Perivulvar pore.

Coll. No. 345"; based on notes taken when the Maskell collection was loaned to Morrison, the above specimens probably were collected on geranium in 1893 and were sent to Maskell by Green.

As is true of most Targioni-Tozzetti species, we have been unable to locate any

of the type series. (See Danzig and Kerzhner, 1981, and Miller, 1981, for the designation of a neotype of *Pseudococcus longispinus* (Targioni-Tozzetti)). Therefore, in order to stabilize the identity of *Diaspis pentagona* Targioni-Tozzetti and to avoid further confusion among closely related species, we have selected a neotype that is labelled as follows: Left label "Canzo, Italy/II-11-1982/on Mulberry/coll: A. Tranfaglia"; right label "Neotype/Diaspis/pentagona/Targioni-Tozzetti/desig. Davidson/& Miller 1983." In addition to the neotype there are 24 paraneotypes. The neotype and several paraneotypes are deposited in the collection of the Instituto di Entomologia Agraria, Portici, Naples, Italy. Additional specimens from the same series are deposited in Auburn University, Auburn, Alabama; British Museum (Natural History), London; California Department of Food and Agriculture, Sacramento; Florida State Collection of Arthropods, Gainesville; Museo de Historia Natural de Ciudad de Mexico, Mexico D.F.; Museum National d'Histoire Natural, Paris; University of California, Davis; University of Georgia, Experiment; University of Hawaii at Manoa, Honolulu; National Museum of Natural History, Washington, D.C.; Virginia Polytechnic Institute and State University, Blacksburg; and Zoological Institute, Academy of Sciences of USSR, Leningrad.

Differentiating morphological characters.—On the pygidium the third space usually has 1 gland spine (Fig. 1A); the second, third, or fourth spaces has at least 1, usually more, bifid or trifid gland spines (Fig. 1B); there are 5–22 (12) small macroducts (Fig. 1C) on each side of the metathorax and abdominal segment I; there are 40–106 (68) large macroducts (Fig. 1D) on each side of the body; and there are 51–124 (75) perivulvar pores (Fig. 1E) on each side of the pygidium.

Differentiating field characters.—Eggs are either light salmon or white. A single female may lay all salmon eggs, all white eggs, or a combination of both.

Hosts.—We have examined specimens of this scale collected from 88 genera of host plants. Borchsenius (1966) recorded it from 108 genera of plants and Dekle (1977) reported it from 115 genera. In the United States the white peach scale is commonly collected on *Prunus persica* (L.), *Morus alba*, *Callicarpa* spp., *Diospyros* spp., and *Melia azedarach* L. It has not been reported on *Syringa* spp.

Distribution.—This species generally is found in tropical and subtropical areas of the world. We have examined specimens from Africa, Asia, Australia, the Caribbean Islands, Central America, the Pacific Islands, South America, and western Europe. In the United States we have seen material from Alabama, California, the District of Columbia, Florida, Georgia, Hawaii, Indiana, Louisiana, Maryland, Mississippi, New Mexico, North Carolina, South Carolina, Tennessee, Texas, and Virginia. The records from California, Hawaii, Indiana, and New Mexico are based on a single collection and may not represent established populations.

Life history observations.—In 1981: May 27—settled crawlers; June 19—mostly newly-molted adult females; June 26—adult females; July 1—egg-laying adult females and a few crawlers; July 6—eggs and crawlers; July 14—primarily crawlers; July 22—prepupal and pupal males, mostly second-instar females, and a few adult females; August 20—egg-laying adult females and eggs; August 29—eggs and a few crawlers; October 16—adult males, adult females, and a few second-instar females. In 1982: May 4—adult female and first eggs of season; July 7—adult females and eggs.

Pseudaulacaspis prunicola (Maskell)

Fig. 2

Suggested common name.—White prunicola scale.

Synonyms and combinations.—*Chionaspis prunicola* Maskell 1895: 49; *Diaspis amygdali* var. *rubra* Maskell (in part) 1898: 228; *Diaspis auranticolor* Cockerell 1899: 106; *Howardia prunicola* (Maskell): Kirkaldy 1902: 112; *Aulacaspis pentagona rubra* (Maskell): Fernald 1903: 235; *Aulacaspis pentagona auranticolor* (Cockerell): Carnes 1907: 160; *Diaspis rubra* Maskell: Scott 1952: 35, *Pseudaulacaspis prunicola* (Maskell): Kawai 1980: 275.

Type material.—The lectotype of *Chionaspis prunicola* Maskell is being designated by Butcher (personal communication) and is deposited in the New Zealand Arthropod Collection, Auckland. We have examined this specimen and have confirmed that it is the same species as other material mentioned in this description. Four additional specimens from the type series are in the National Museum of Natural History, Coccoidea Collection, Beltsville, Maryland. The species originally was described from Hawaii on “Japanese plum.” Based on the fact that the scale was killing the trees, Maskell wrote “I presume therefore that the insect originally comes from Japan.” It is interesting to note that white prunicola scale has never been recorded from Hawaii since the original description. We have examined specimens of the following junior synonyms and have confirmed that they are the same as *P. prunicola*. *Diaspis amygdali* var. *rubra*—6 slides from Ceylon with Maskell Collection number 565 and 1 slide with label “*Diaspis/amygdali* var./*rubra* Mask/Loranthus?/Orixia japonica/Ceylon & Japan/Maskell Coll. 565/PHOTO.” The first six slides are the same as *Pseudaulacaspis barberi* (Green) 1908; the single slide is the same as *Pseudaulacaspis prunicola*. We believe that these slides are part of the type series but were mounted from dry material after the species was described. The single slide is probably from Japan. *Diaspis auranticolor*—1 slide with label “*Diaspis/auranticolor/Ckll./Cotype/Japan*.” This material apparently is from the type series but was mounted from dry specimens after the species was described.

Differentiating morphological characters.—On the pygidium the third space usually has 2 or more gland spines (Fig. 2A); the second, third, and fourth spaces usually have simple gland spines only (Fig. 2B); there are 0–15 (4) small macroducts (Fig. 2C) on each side of the metathorax and abdominal segment I; there are 38–86 (58) large macroducts (Fig. 2D) on each side of the body; and there are 35–99 (65) perivulvar pores (Fig. 2E) on each side of the pygidium.

Differentiating field characters.—Eggs are always light salmon in color.

Hosts.—We have examined specimens of this scale collected on 21 genera of host plants. In the United States the white prunicola scale is commonly collected on *Prunus* spp., particularly *P. serrulata*, and on *Ligustrum* spp. and *Syringa* spp.

Distribution.—This species generally is found in temperate areas of the world. We have examined specimens from the People's Republic of China, Japan, Korea, Okinawa, and Taiwan. In the United States we have seen material from Alabama, California, Connecticut, the District of Columbia, Florida, Hawaii, Louisiana, Maryland, Massachusetts, Mississippi, New Jersey, New York, North Carolina, Ohio, Oregon, Pennsylvania, Rhode Island, Virginia, and West Virginia. The species is known from only a single collection from California, Hawaii, and Oregon; these records may not represent established populations.



Fig. 2. *Pseudaulacaspis prunicola*, adult female, Hawaii, 1894, on "Japanese Plum." A, Gland spines in third space. B, Simple gland spine. C, Small macroduct. D, Large macroduct. E, Perivulvar pore.

Life history observations.—In 1981: May 5—eggs and a few crawlers; May 26—second-instar males and females; June 9—newly-molted adult females; June 24—adult females and eggs; June 29—adult females and eggs; July 1—crawlers and a few eggs; July 6—crawlers; July 14—mostly second-instar males and females;

Table 1. Comparison of four characters between *Pseudaulacaspis pentagona* and *P. prunicola*. For each character, differences between species were detected with a student's *t*-test. For each species significant differences were found in the numbers of small macroducts, total large macroducts, perivulvar pores, and gland spines.

Characters	Species	Mean	± Standard Error	n	t-test value	Level of significance
Number of small macroducts on methathorax and seg. I	<i>pent.</i>	11.72	.48	56	12.20	$P < .001$
	<i>prun.</i>	4.81	.32	62		
Number of large macroducts	<i>pent.</i>	67.66	2.28	50	3.57	$P < .001$
	<i>prun.</i>	57.64	1.59	47		
Number of perivulvar pores	<i>pent.</i>	76.04	2.21	65	3.92	$P < .002$
	<i>prun.</i>	65.39	1.60	67		
Number of gland spines	<i>pent.</i>	1.05	.03	65	12.56	$P < .001$
	<i>prun.</i>	2.07	.08	58		

August 17—mostly eggs; August 18—eggs; August 20—eggs and crawlers; September 24—adult males and adult females. In 1982: April 26—many eggs; May 6—first crawlers.

Host transfer information.—Transfer of specimens to potato was more successful with the white peach scale. Each potato had approximately 100 settled crawlers when the dried mulberry twig was removed. In the case of the white prunicola scale, each potato had only 40–50 settled crawlers when the cherry twig was removed. After two generations on the potatoes each species maintained its separate identity with the exception of two specimens of white peach scale that were found on a potato in a prunicola scale colony. We believe that these specimens were accidentally introduced as contaminants on the microscope that was used to examine both populations. Inspection of the remainder of the population on the cross contaminated potato revealed no more material of the white peach scale.

DISCUSSION

The following information suggests that the white peach scale, *Pseudaulacaspis pentagona*, and the white prunicola scale, *P. prunicola*, are separate and distinct species. Morphologically most taxonomic characters show some overlap but are statistically significant at the .001 or .002 levels (Table 1). The white peach scale has more perivulvar pores, more large macroducts, more small macroducts on the metathorax and abdominal segment I, and has fewer gland spines in the third space. Kawai (1980) used characteristics of the gland spines and antennae to separate the species. We were unable to detect significant differences in the morphology of the antennae.

The eggs of the white peach scale may be white or salmon, whereas those of white prunicola scale are always salmon. According to Bennett and Brown (1958) in white peach scale the salmon eggs contain female embryos and the white eggs contain males. We did not test this hypothesis.

Both species are polyphagous, but each is most commonly collected on different hosts. In the Washington, D.C. region, the white peach scale is most frequently collected on mulberry, *Morus alba*; and the white prunicola scale is most often found on Japanese flowering cherry, *Prunus serrulata*.

In terms of geographic distribution, the white peach scale tends to be a more tropical or subtropical species, whereas the white prunicola scale is a more temperate species. Occurrence of the white peach scale in Indiana and the presence of the white prunicola scale in California, Florida, Hawaii, Louisiana, Mississippi, and Okinawa are exceptions to this general pattern. Many of these records are based on one or two collections and may represent infestations that did not become established.

Our life-history observations suggest that the white peach scale begins its activity later in the year than the white prunicola scale, and that this delay remains throughout the season. We found three generations each year in both species. Based on voucher specimens deposited in the National Museum of Natural History, the life-history study of Stimmel (1982) pertains to *P. prunicola*. He found only two generations each year in the cool climate of northeastern Pennsylvania on *Prunus serrulata*.

Both species maintained their unique taxonomic integrity even when they were transferred to potatoes and were maintained under similar environmental conditions. If there were some host-induced-influences on these characteristics, we did not observe them.

Small series of first instars and second-instar males of each species were studied to determine if major differences could be discovered that would support our findings with the morphology of the adult females. Unfortunately, only minor differences were found, and it was beyond the scope of this paper to determine if these differences were interspecific or intraspecific.

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